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CONTENTS

Indeterminism and the Concept of Physical Reality: V. F. LENZEN 281

The Metaphysical and the Logical Individual: PAUL WEISS 288

Material Truth in Rational Thinking: KURT EDWARD ROSINGER 293

Book Reviews:

Lewis and Langford's Symbolic Logic: HENRY BRADFORD SMITH 302

Journals and New Books 306

Notes and News:

Letter from John Laird 307

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THE JOURNAL OF PHILOSOPHY

INDETERMINISM AND THE CONCEPT OF PHYSICAL REALITY[1]

I

I SHALL begin this contribution to the symposium on Chance and Cosmogony with a brief discussion of chance. Chance characterizes the occurrence of events. In daily life we apply the term "chance"[2] to events which occur without intention. Thus we say that one meets a person by chance if the meeting is not the result of a purpose or intention. But we also apply the term "chance" to physical events which are recognized to be independent of human intentions. In this paper I shall discuss only physical chance.

Now physical events are characterized by laws of connection between events. Physical events can be ordered in causal sequences, so that a specific event may be described as the effect of other events. If an event can not be exhibited as a member of a system of sequences we ascribe its occurrence to chance. An event whose causal antecedents can not be demonstrated is viewed as a matter of chance. The illustration from daily life and physical events both exemplify that chance is the occurrence of events for which a specific ground or reason has not been exhibited.

An example of a physical event which is described as a matter of chance is the occurrence of heads or tails when a coin is tossed and allowed to fall on a flat surface. There are two possible events, and each has the same chance of occurrence. If we toss two coins the chance of two heads or two tails is not as great as the chance of one head and one tail. Thus there are degrees of chance. The degree of chance of an event is measured by its probability of occurrence. Hence on my interpretation chance is the occurrence of events in accordance with laws of probability.

In order to define the probability of an event I shall consider another physical event, the throwing of a die. Since the die has six faces there are six possible results of a throw. If the die is of uni-

[1] Contributed to a symposium on Chance and Cosmogony at a meeting of the Pacific Division of the American Philosophical Association, December 27, 1932, at Mills College, California.

[2] Compare P. Frank, *Das Kausalgesetz*, Chap. 6 (1932).

form density the probability of any given face becoming the top face is one-sixth; each of the possible events has the same probability of occurrence. The meaning of the preceding statement is defined as follows. Suppose that one throws the die N times, and that in n_i times the ith face appears. As N increases, the fraction n_i/N will fluctuate about the value one sixth for each face. Accordingly we say that there are six possible events, each of which has the probability one sixth. The probability for a single event is thus defined in terms of a statistical ratio. Let me recall that the empirical condition that all the possible events occur with equal probability is that the die be of uniform density.

We have now seen that the occurrence of chance events is described by a statistical law. Thus the ratio n_i/N fluctuates about a fixed value $P_i = \frac{1}{6}$. If a large number of trials (N) is made, the ith face will occur approximately n_i times, where $n_i = P_i N$. Chance events occur in accordance with a statistical regularity.

The statistical law, however, requires certain causal laws as a foundation. Thus for the chance event there is a set of possible results which is determined by definite laws. For example, the six possibilities in the throwing of a die depend upon the determinate fact that a die has six faces. Furthermore, the die is in stable equilibrium only when resting flat on a face. This is determined by the causal laws of mechanics. Thus the chance event, which is governed by a statistical law, occurs in a definite setting. We say, however, that it is a matter of chance which of the equally probable chance events will occur. We can define the probability of the chance event.

I remarked that the statistical law presupposes a background which is determined by causal laws. Now, as a matter of fact, the chance event upon more detailed analysis may be explained in terms of causal laws. Thus, although the outcome of throwing a die is described in terms of chance, in classical physics one would characterize the event as in fact causally determined. We are not able to specify the initial and accompanying conditions with sufficient completeness in order to exhibit the event as an occurrence determined by causal laws. Description in terms of probability is thereby to be viewed as an expression of ignorance.

Thus within the system of classical deterministic physics we may view all physical events as determined by causal laws. On account of our inability to apply these laws in detail we characterize some events as a matter of chance. The occurrence of such chance events is described in terms of statistical laws. From this point of view the concept of chance expresses absence of knowledge. The possibility is suggested, however, that the statistical laws regulate the occur-

rence of events which are not determined in detail. Chance would then be objective. The description of events in terms of objective or real chance, that is, in terms of statistical laws which one does not attempt to analyze further, has been realized in the new quantum theory.

II

The quantum theory represents the physical order as indeterminate. I propose to analyze this indeterminism and its philosophical presuppositions.

Physical description starts from the fact that the values of several physical quantities characterize a system. Thus a system may be characterized by the position of its elements at a given time, their momentum, energy, electric charge, temperature, etc. Physical laws are functional relations between physical quantities.

We may contrast deterministic and indeterministic physics.

Classical physics was deterministic. A system was characterized by definite, determinate physical quantities. Thus a particle was assumed to have a definite position at a definite time and also to have definite momentum and energy. To the physical object was attributed a definite, determinate structure. Furthermore, the course of physical processes was determined. Given the state of a system at a specified time, one could predict the state at some future time. In deterministic physics the present state determines the future state. Thus deterministic classical physics assumed determinateness in the momentary structure of physical reality and determinism of the future by the structure of the present.

Contemporary physics, as exemplified by the quantum theory, is indeterministic. In the first place indeterminateness in structure is ascribed to a physical system. Thus one distinguishes between complementary sets of quantities, space-time quantities and momentum and energy. The complementary quantities do not simultaneously characterize a system with complete determinateness. Determinateness in space and time is accompanied by indeterminateness in momentum and energy and vice versa. The reciprocal limitation of the complementary modes of determination is expressed by Heisenberg's principle of indeterminacy. Furthermore, since the present state is not completely determinate, one can not have a principle that the present determines the future.

The quantum theoretical indeterminism may be expressed in the following manner. Suppose that we have given a physical system. There will be associated with the system sets of possible values of the physical quantities which characterize it.[3] Each possible value

[3] Compare L. de Broglie, *Théorie de la Quantification dans la nouvelle Mécanique* (1932).

of a physical quantity is characterized by the probability that the system will be found to have that possible value. The probability functions satisfy determinate laws. The realization of a possibility, however, is a matter of chance, the degree of chance being expressed by the probability of occurrence of the specific possibility.

III

The foregoing exposition of indeterminacy presents a problem of interpretation. I initiate the discussion with the question, what knowledge of the physical world is expressed by physical science? As an example of a formula which expresses a typical physical law let us take $F = ma$, which expresses Newton's second law of motion. The expression of this equation in words is that the force acting on a body is equal to its mass times its acceleration. What do the symbols denote? There are two interpretations.

One view is that the symbols represent properties of things or processes in the physical world. Thus the symbol m for mass denotes a property of a body. We may hold that the symbol F for force denotes the strength of an activity, or we may abandon the concept of force as an activity and use only the concepts of mass and acceleration. In any case, the formula $F = ma$ expresses a relation between properties in the physical world. In the formula the conjunction of symbols m and a must not be interpreted as a multiplication of numbers, but as a multiplication of properties. In some physical equations the square of a symbol occurs. Thus the law of falling bodies is expressed by $s = \frac{1}{2}\, gt^2$. On the present interpretation of the symbols t^2 is not the square of a number, but the square of a property, whatever that may mean. If we suppose that our equations refer to properties, and not to numbers, we must recognize that the indicated operations are upon properties. The formal laws for the operations upon properties are the same as those for the operations upon numbers. The interpretation of symbols as denoting properties has been expounded especially by R. C. Tolman.

Now I admit that it is natural to interpret some formulae as directly expressing relations between properties. If we add a length to itself we obtain a length which is double the original length. The operation is expressed by $l + l = 2l$. It seems natural to interpret this formula as applying to the property length in the external world. I think, however, that the foregoing interpretation is unnatural for more complicated formulae in which we have symbols such as t^2. Accordingly, I turn to the view that the symbols refer to numbers which express the results of measurement.

On this view, the symbol F denotes a number relative to a given

unit, similarly m and a denote numbers. The equation $F = ma$ states, it is possible to assign numbers F, m, a such that $F = ma$. Now if we assume that the numbers are assigned to properties, there must be a one-to-one correspondence between measure-numbers and properties, so that the operations on measures should parallel the operations on properties. The interpretation of addition is particularly simple. The formula $l + l = 2l$ may be interpreted naturally in terms of properties or in terms of numbers assigned to the properties.

Although I have contrasted the two interpretations we must recognize both points of view. An empirical analysis of the significance of physics reveals the following. Physical objects are assumed to have various properties such as length, mass, etc. Length, in particular, has an intuitive basis, for there is a sense in which we can see or feel a length. But we also assign numbers to properties in measurement. In the mathematical formulation of physical theory the number substitutes for the property.

If we assume that our equations express relations between numbers, the indeterminacy of the quantum theory can be attributed to the fact that measurement disturbs the state of the system so that the result can be predicted only with a specific probability. The measurement of one quantity disturbs the determinateness of a complementary quantity. Thus the indeterminacy is frankly recognized as pertaining to our measurements. But since the measurements constitute the data of physical theory we can not go behind this indeterminacy. Such an interpretation may be called operational or symbolic.

We may insist, however, that the measures stand for properties, that the property has an intrinsic nature which is other than the measure. We may further adopt the view that the property is constituted by the context which is provided in the process of measurement. It would then appear that the property shares the indeterminacy of the measure. We thereby extend the indeterminacy from the measure to the property. This extension is based upon the assumption that to every measure there corresponds a property, and that indeterminacy in the measure indicates indeterminacy in the property.

I pause a moment to consider the nature of the assumption. We may interpret it as an hypothesis or a postulate. I assume that an hypothesis is an assumption of which it is significant to say that it is true or false. Now our knowledge of physical reality is obtained primarily through measures. Thus the interpretation of our assumption as an hypothesis implies that there is some other means of gaining access to the property. In the case of length we have

intuitive knowledge, but such direct access to properties is for the most part absent. If we interpret our assumption as an hypothesis we must therefore, as Philipp Frank has pointed out, assume the existence of an omniscient intelligence to whom the hypothesis would be significant. I remark parenthetically that this type of argument was employed by Royce who inferred the existence of the Absolute from the possibility of error.

The other interpretation of the assumption is that it is a postulate which defines the property in terms of its correspondence to the measure. The property is constituted in the process of measurement. From a positivistic point of view such a property would seem to be superfluous.

IV

Now whether one emphasizes the property or measure there are further aspects of indeterminacy which must be analyzed.

The system upon which we act in performing a specific experiment is characterized by one or more sets of possible results—possible measures or possible properties. The outcome of the experiment is in general not determinate. In this sense the structure of physical reality has an element of indeterminateness; before measurement a physical property or its numerical representation consists in a set of possibilities. I now raise the question; what is the status of the possibilities while they are possibilities?

On one view the concept of possibility is to be chosen as fundamental. At best one may give an explanation such as the following: if one acts on the system in a prescribed manner any one of a set of results may be realized. It is certain that one of the set will be realized.

One may, however, seek a ground of possibility by some form of realism. In a neo-realistic theory of possibility the elementary possibilities may be assumed to be real entities. The realization of a possibility is merely the discovery of something real. The indeterminateness of physical reality is thereby explained as a multiple determinateness. In a dualistic theory of the possibilities of physical determination one seeks the ground of possibility in some entity behind phenomena. The realization of a possibility is the action of this entity upon the subject. Thus on the dualistic view one adopts the concept of a reality which transcends experience. There are then two modes of accounting for the indeterminateness in the results of measurement. We may ascribe an indeterminateness to the transcendent reality, or we may postulate a determinate reality which acts in an indeterminate manner upon the subject. Thus on dualistic assumptions one can retain the concept of determinate reality; indeterminacy becomes a matter of experience or knowledge.

The principle of indeterminacy then becomes a principle of uncertainty.

The conclusion of the discussion is that the interpretation of indeterminacy in quantum theory depends upon one's philosophical attitude. One can preserve determinism in the physical order if one accepts a dualistic theory of knowledge. This result is similar to the conclusion that one can preserve absolute space and time by a dualistic theory. I cite, for example, the views of A. O. Lovejoy and R. W. Sellars. I think, however, that for the most part the interpreters of the quantum theory accept indeterminateness as a fundamental characteristic of physical reality. Thus independently of the views that one holds concerning the nature or ground of the possibilities of physical experience one may accept the theory of indeterminism in the physical order.

V

Thus far I have emphasized the aspect of indeterminacy in physical reality. We must, however, recognize that there are elements of determinism left in indeterministic physics. We have seen that the result of a measurement is one of a set of possibilities. Now the set of possibilities is determined. The general formulation is that the nature of the system with respect to a certain property is expressed by the structure of an operator. The characteristic values of the operator are the possible results of a measurement of the property. This is determinism. Again, the average values of a physical quantity are determined. Now macroscopic or large-scale phenomena are the manifestation of the combined action of many elementary processes. Measured macroscopic quantities are determined by average values except for chance fluctuations. Thus macroscopic processes are subject to causal laws except for chance fluctuations. Since classical physics deals with large-scale processes it therefore finds a place in the new indeterministic physics. Again, the observation of elementary processes requires a macroscopic environment as a background or setting. The description of experimental conditions which furnish the basis for indeterministic physics thus presupposes classical deterministic physics to the first approximation.

VI

A contemporary paper on indeterminism is probably incomplete without an application to biology. And so while I emphatically disclaim responsibility for the following ideas, I think it will be of interest to sketch the attempted extension of fundamental physical ideas for the reconciliation of the issue between vitalism and mechanism.

We have seen that a fundamental concept of quantum physics is the concept of complementarity. For the description of atomic processes, for example, we have two mutually exclusive, but complementary sets of quantities, namely, space-time coördinates and momentum and energy. Determinateness in space and time involves indeterminateness in momentum and energy, and vice versa. The reciprocal limitation of the complementary quantities is expressed by the principle of indeterminacy.

Bohr, seconded by P. Jordan,[4] has extended the concept of complementarity for the purpose of determining the relation between vitalistic and mechanical descriptions of organic phenomena. An organism may be described in terms of vitalistic concepts, but then the possibility of physico-chemical description is abandoned. Or the organism may be described as a mechanism which obeys the laws of the physical order. But the physical description of an organism implies that it has been observed and hence acted upon. The interference with the organism for the purpose of physical description damages its vital functions and in the limit of complete mechanical description results in the death of the organism. The gradual destruction of the vitality of the organism during the process of scientific investigation is correlated with a limitation of the subjective feeling of freedom of action. Vitalism and mechanism are thus viewed as mutually exclusive, but complementary, modes of description of organic phenomena. Just as the determination of the position of an electron disturbs its momentum, so does the observation of the mechanism of the organism destroy its vitality. In a reciprocal manner, the representation of an organic process as vital requires the abandonment of mechanical description.

V. F. Lenzen.

University of California.

THE METAPHYSICAL AND THE LOGICAL INDIVIDUAL[1]

IT is almost a slogan today in philosophy that there are no material certain propositions. But to me it is indubitable that the proposition "Some day in some place I shall meet myself coming toward me" is an absurd material proposition and its denial material and certain. So much for the quest for uncertainty. I know I am a unique, unrepeatable individual and that there is no sense in the supposition of myself being duplicated. If there be a choice between a dialectic which results in the rejection of the claim which

[4] *Die Naturwissenshaften*, Nov. 4, 1932.

[1] Read before the December, 1932, meeting of the Eastern Division of the American Philosophical Association, Bryn Mawr.

I make to individuality, and the blunt statement that I, a unique being, do exist, I shall certainly choose the latter. I don't know myself completely, but I am as certain as I am of anything that I am something whose being is not to be found in any collection of sharable properties.

But the arguments which deny the existence of individuals must be met. Three, at least, are basic and fairly common. The first denies that there can be any individuals, because individuals must be either complex or simple—capable of division or not. But if they were complex, they would have an intelligible character, and would then no longer be pure individuals. The complex can be divided and the divided consists of distinct parts united by an intelligible form or relation. As such a form is general and is essential to the complex, the complex must be constituted by and not, as an individual, be something set over against a general character. If, on the contrary, individuals were simples, they could not exist. To exist is to have a temporal spread. A temporal spread involves connection between a past and a future and thus implies complexity. An existent, simple individual would, then, self-contradictorily, be complex.

The second argument holds that if there were individuals, as distinct from general characters, it is conceivable that any number of individuals might have the same characters in common and differ from one another only in that they were different individuals. But these different individuals would nevertheless have in common the character of being unique, so that individuals which had every character in common except their uniqueness, would self-contradictorily have also their uniqueness in common.

The third argument is to the effect that the individual can not be known because all knowledge is in terms of generals. No knowledge has an individual as its content, but only refers to it. And that which can never be directly known under any conceivable circumstances can not significantly be said to exist.

These arguments seem to show that the individual is at once incapable of complexity, existence, uniqueness, and comprehension. They seem to leave us with the unpleasant dilemma of rejecting the existence of individuals (and thus the certainty that we exist and are individuals), or of being content with the irrational and unknowable. The strength of these arguments, however, consists mainly in the fact that they are based on ambiguities due to the failure to make proper distinctions.

It is quite common to reply to these arguments with an opposing set, of which the following are typical. Firstly, it is asserted that there are individuals, because whatever is complex can always

be divided into more basic elements, and the individual is that ultimate indivisible presupposed as the unit out of which the complex is constructed. A second argument urges that there must be individuals because entities sharing the same traits are distinguishable and there must be something besides general characters to make the distinction possible. A third argument maintains that there must be individuals, for otherwise the objects of imagination could not be differentiated from those *in re*. Individuality is here taken to be the element of obdurateness in fact which differentiates fact from fancy. These arguments defend the existence of individuals on the ground that without them there would be nothing simple or complex, no numerical differences and no distinction between fact and fiction; but they are based on an incorrect analysis of the individual, as can be seen from the following criticism of the first set of arguments.

The first argument, to the effect that there could be no individuals because simples can not exist and complexities are not individuals, fails to differentiate between logical and metaphysical individuals. A logical individual is an argument to a propositional function, such as ". . . is red." A metaphysical individual[2] is the indivisible, existential unity from which both logical individuals and their characterizing predicates are derived by abstraction. The argument effectively shows only that logical individuals, being simples, can not exist. It does not, however, deal with the metaphysical individual which is actually neither simple nor complex, but potentially both simple and complex. The metaphysical individual is complex in the sense that from it a multiplicity of distinguishable predicates can be abstracted. In a similar sense it is simple, for it yields the logical individual as an abstraction. This logical individual is simple, unanalyzable, and non-existent. Both it and the predicates are derivatives from the metaphysical individual because the metaphysical individual is a what imbued with existence, a that suffused with intelligibility, characters before they are shorn of their existence; existence before it has been sundered from that which exists; the source of the complex and of the simple. It is, in short, a pair of correlative abstractions before they are abstracted, and thus before they are correlative or a pair.

[2] The term "metaphysical individual" is here used in contrast to "logical individual." Professor John Dewey, by a well-turned question, has made me see that there are speculatively distinguishable aspects of the real, here called the metaphysical, individual. Three of these aspects, I think, are fairly obvious. There is the felt individual, as given; the ontological individual as private; and the metaphysical individual proper, the unity and source of the other two. The arguments of this paper are framed sometimes in terms of one and sometimes in terms of another of these aspects without, I think, in any way effecting the strength of the thesis.

The second argument, which denies that there are individuals because all individuals share the character of uniqueness, refers to both metaphysical and logical individuals. It supposes falsely that the uniqueness of the individual is due to the possession of the character "uniqueness." But the individual is not the product of characters, one of which is "uniqueness." The individual is a private being, and privacy is essentially unsharable and uncontemplatable. It can be reacted to or lived through—it can not be possessed in contemplation. We can not ask how individuals come to be, for such a question not only supposes individuals to be derivative rather than foundational, but the very form of the question denies the possibility of an answer. We can answer the question "what makes an individual" only by offering some general character, and that general character would be something sharable and therefore insufficient to determine an individual. To ask for a principle of individuation is to suppose that characters have an independent being apart from the individual and that some other element must be added to these characters enabling them to participate in or to constitute the individual, whereas all characters are abstractions from the already existing individuals. There is no more justification in the quest for a principle of individuation than there is in the quest for the principle of being, or any other fundamental non-derivative categorical aspect of the universe.

The final argument denied that there were individuals, because individuals can not be possessed in knowledge. This argument falsely assumes that knowledge consists in the contemplation of characters. In this sense of knowledge, it is true that individuals can not be known. Only characters can be contemplated, and these only when abstracted. The concrete metaphysical individual must be lived through or felt. We can know that there are such entities by noting that there must be a common locus for both logical individuals and characters and this locus can be neither a logical individual nor a character. And there must be such a locus if a singular proposition (whose subject is a logical individual and whose predicate is an abstract universal) is to have a definite meaning and a single reference. We can differentiate individuals by noting the different acts of indication necessary to specify the logical individuals abstracted from them. We can know the nature of any given metaphysical individual by studying the characters abstracted from it. And we can understand the difference between the metaphysical individual and any object of indication and of contemplation by noting the difference between the state of being contemplatable without being contemplated, of being indicatable without being indicated. The metaphysical individual transcends knowl-

edge only in the sense of having being apart from knowledge. It does not transcend it in the sense of being beyond knowledge, for all its characters can be contemplated, and what remains after the abstraction of the contemplated can always be indicated. Our knowledge has abstractions, not metaphysical individuals as its content; but it can be about such individuals so long as the abstractions from them are recognized to be abstractions. This recognition is involved in the assertion that characters are predicates of the existing, and that the existing is intelligible, while every character as known is without existence, and every logical individual, as indicated, is devoid of characters. And we can make this assertion and do make it whenever we insist on the fact that what we know is always less than or not identical with what is.

We can now see that the traditional defense of the existence of individuals is based on misconceptions. The first argument defended the existence of individuals on the ground that they were the ultimate constituents of the complex. The metaphysical individual, however, is not a constituent of but a source of the complex, just as it is not that which is simple, but the source of it. If individuals were the ultimate constituents of the complex, the very being of complexity would be a miracle, for in order to obtain such complexity it would be necessary to relate the individuals to one another. But this could not be done until the relation had first been related to the individuals and so on without end. The second argument defended the existence of individuals on the ground that they made discriminations possible. Such an argument falsely supposes that metaphysical individuals are contemplatable, for if they make discrimination possible they must be in knowledge with or before the discriminated. But if the individual were contemplable, how could the contemplated be referred to it? We discriminate in terms of logical individuals, and metaphysical individuals make discriminations possible only in the sense that logical individuals are derived from them. The third argument defends the existence of individuals on the ground that they are the obdurate elements in the world. Obduracy is not a character of the metaphysical individuals but of logical individuals, because logical individuals are brute abstractions, not amenable to thought; it is also a character of predicates because each predicate is eternally what it is. The metaphysical individual is obdurate in the sense that these obdurate entities are definitely and really derived from it, and as the occasion for the feeling of force experienced in our knowledge of characters. It is the source of inescapable elements and not the inescapability of the elements themselves. If it were the inescapability of the elements, it would be an abstraction from them, some-

thing rarefied and non-existent, sharable and predicable, rather than that which is the most concretely real, to which all subjects and predicates must be referred as locus.

The metaphysical individual, in short, is concrete privacy, the referent of all singular propositions, the source of all our knowledge, neither compacted out of universals, nor a limit approachable by multiplying abstractions. It can never be possessed for its very being consists in its externality to everything else. Yet it can be intruded upon, and is intruded upon whenever it is forced to experience, for the content of experience—feelings, and abstractions —are the products of a violated privacy, forced to recognize the existence of other individuals. How this is possible is the problem of the internalization of that which is essentially external—another, but profounder question, to which perhaps we shall have occasion to refer again.

PAUL WEISS.

BRYN MAWR COLLEGE.

MATERIAL TRUTH IN RATIONAL THINKING

THIS paper proposes the thesis that all rational activity is of the type of mathematical reasoning; that the truth of any proposition is identical with mathematical or formal truth, and that when, in the inductive sciences, we approximate to truth, we approximate to formal truth; that, finally, if "truth" as apart from validity has any significance whatsoever, that significance is to be apprehended by mystical intuition alone. The aim of man's rational activities is to discover consistent sets of propositions. He speaks of truth, but thinks of consistency. He sets truth upon a pedestal; then conveniently, and of necessity, ignores it, for its introduction into rational thinking is gratuitous. It must not be inferred from these words, however, that the consistency theory of truth is here to be promulgated. No attempt will be made to identify truth with consistency. No such monstrous assumption finds its way into this paper.

The distinction between "formal" and "material" truth is well known. A proposition is formally true if it has been validly deduced from given premises. Material truth can not be defined so easily. I do not know the *meaning* of the word. I *feel* that it refers to some "actual" state of affairs transcending conceptual systems; that "real" world of which the mystic, through direct intuition, is aware —direct intuition breaking through the walls of conceptual systems within which the rational thinker is a life-long prisoner. Consequently the mystic claims that his intuitive knowledge can not be

described or otherwise expressed in words; that he who wishes to know truth must be his own teacher, must be *one* with reality. Of the Tao, say certain mystics, nothing true can be said, and all that is said is false. Material truth enjoys the privacy of the Tao. It is the truth to which we *refer* when we say "It is true that this book is red," or when we assert the truth of a scientific or philosophical proposition. Yet it is not the truth which we *discover* when we verify these propositions, nor, do I believe, can this truth ever be discovered except through mystical experiences. Hence those of us deprived of the abilities of the mystic can never discover material truth. We who are limited to the tools of reason: concepts, logic, experimentation, must satisfy ourselves with formal truth, while those, furthermore, who are sceptical of the mystic must, *a fortiori*, doubt the very existence of material truth. If the following discussion commands assent, truth, as a valuable concept in rational activity, as an attainable goal, must be relegated to the limbo of noble fictions.

II

There are a number of intellectual activities in which truth seems to play a fundamental rôle. Three of these shall be considered here: science, philosophy, and every-day experience. The stand which this paper takes is that all intellectual activity, whether it is as advanced and refined as physics or philosophy, descriptive and immature as certain sections of biology, or naïve and often unattended to as in every-day experience, is theoretically similar in logical structure to systematic mathematical reasoning. It, whether consciously or not, always lays down certain assumptions, postulates, or *a priori* principles, in terms of given, and therefore undefined, concepts. From these principles it deduces subsidiary propositions. The chief rôle of experience or experimentation is to call forth the proper conceptual system and to serve as a determinator and regulator of assumptions. The propositions, judgments, or conclusions of intellectual activity derive their truth from their formal relations to the body of propositions constituting the system of which they are a part. In what follows we shall try to establish this view, first describing a pure mathematical system.

A mathematical system in strict logical form is one based on a number of undefined concepts, some of which are classes of entities, others relations. In terms of these, a number of postulates or assumptions are made, their assumptive character being that they are "true." Truth, in this context, does not mean that the postulates state facts or that they are representative of reality; it merely means that they are arbitrarily chosen propositions descriptive of certain relations holding among the undefined elements. The

logical analysis of the meaning of truth when applied to an assumption is the following. Every proposition serves as an argument to a certain logical function $F(p)$ called, deceptively, a truth-function. The number of values assignable to a truth-function differs in different systems. Ordinarily there are two, although n-valued systems, where n is greater than 2, have been developed. From among the class of truth-values one (let it be symbolized by the figure 1) is chosen as determining the laws of the system. Thus any proposition p such that $F(p) = 1$ is a law of the system. A postulate is "true" because the assumption is made prior to the development of the system, that the value of the truth-function to which it is an argument is that chosen law-determining truth-value. Clearly this is far removed from what is commonly called truth. An extensive discussion of truth-values is found in Lewis and Langford: *Symbolic Logic.*

From these postulates other propositions are deduced, which are the theorems of the system; and from the undefined concepts new ones are constructed, which are defined in terms of the former. Thus the entire system is based on the undefined concepts and the postulates; the structure and the truth of the theorems are determined by the set of assumptions. A proposition is a theorem of the system if it is validly deducible from the set. It is then true, formally. The claim is made here that this is the only truth which we can ever know in rational activity, for all rational activity consists in thinking in terms of such systems.

The remark may be here interpolated that two systems with different structures are equivalent when, for every proposition of the one there is a correlative in the other. The two systems may be equivalent although the fundamental terms of each are derivative terms of the other. Thus there is no one set of elements which is ultimately simple or fundamental, or any one set of assumptions which claims absolute priority. As this meaning of equivalence is not limited to mathematical systems, but is generally applicable, the question is not being begged by pointing out that there might be two or more metaphysical systems employing different assumptions and different fundamental entities, which nevertheless are equivalent. None of them, then, would describe the "real" nature of the universe, but only the nature of the universe with respect to arbitrarily chosen bases. Stone walls may not a prison make, but logical forms most certainly do—unless there is nothing outside of the systems.

Every intellectual activity demands the creation of a system because of the *a priori* structure necessary to it. Surely it is needless to argue that the intellect, prior to applying itself to a problem,

must make assumptions or hypotheses, and must accept the meanings of some words as known. Since, moreover, the mind casts aside any contemplated propositions inconsistent with these assumptions or with propositions deduced from them, we have here the essential ingredients of a system. It is true that in inductive thinking some propositions claim our assent with such tenacity that if they are inconsistent with the assumptions, it is the latter that are discarded. But these two cases are not disparate. We shall return to the latter later.

A principle immediately apparent in a study of logic is that a proposition is "true" only within a system. A proposition derives its truth, and the concepts of which it is composed gain their very meaning, from the system in which it is found; or if it is not part of an explicit system, then from its universe of discourse. "A straight line is the shortest distance between two points" is true of Euclidean space, i.e., within a system defining Euclidean geometry, but may be false of certain non-Euclidean spaces. The very meaning of "straight," "line," "short," and "point" is a function of the system. The same holds true of propositions not in developed systems. "Asclepius raised the dead" is true of mythology; false in history. Clearly, the truth here referred to is *formal* truth. A statement torn from its context is neither true nor false, nor has it meaning.

Is it possible, then, to find material truth by means of philosophy or science; i.e., can one learn about the real world through these, or is one always limited to knowing the formal truth relative to a system? This paper is not advancing the old notion that by means of intellectual endeavor one can gain only an approximation to the whole truth. Quite to the contrary, we do, or at least can, discover formal truth, but we do not know that we even approximate material truth. In speaking of material truth, I do not assume that there is such a thing. That question does not concern us here. If formal and material truth ever coincide, we could not know it by reason alone. Nor do I believe that we really care. Man in his every-day activities is certainly a pragmatist, while I believe that the scientist or philosopher is trying merely to find consistent systems. And if he claims that consistency is a sufficient condition of material truth, then he is making an extraordinary assumption indeed.

It is desirable to investigate this further by considering a typical philosophical problem. Unfortunately for knowledge in general and the purposes of this paper in particular, there are no rigorous neatly delineated systems in either philosophy or science. Even so-called "systems of philosophy" are but loosely termed such. Although these fields of intellectual endeavor can boast of much close and

careful reasoning, their assumptions are generally implicit and hidden among deductions, while their concepts often lack precise definition. This is not due to any inapplicability of postulational method to their subject-matter, but rather to our ignorance of the subject and its oft-times immense complexity. Theoretically there is nothing impossible in systematizing either a philosophy or even a developing experimental science. Wherever there is rational thinking there are the rudiments of a system, as the term is used here.

Let us consider in their simplest form two theories developed for the explanation of animal behavior. Let the hypothesis of the one be that there exists an anima which controls the physico-chemical bodily machine, and let the other be its contradictory which denies the existence of an anima, but assumes a machine so intricate and delicate that all behavior can be explained in terms of it alone. Both theories can not be "true," for they are contradictories in that one says "Animal behavior can be completely explained in terms of physics and chemistry," while the other maintains that it can not. A careful systematization of each theory might show that one or both need considerable revision. There is also the remote possibility, which would be discovered through logical analysis, that the two systems are equivalent because the contradiction may be merely apparent, and derived from lack of rigor in definitions and reasoning. However, let it be assumed that they are contradictories. If this example should prove to be inadequate, some other would not.

Let us suppose, therefore, that we have two internally consistent but mutually contradictory theories. It being impossible to accept both, which shall be chosen to explain animal behavior? It will be noted that the primary criterion is consistency. A system known to be inconsistent can not claim our assent. But as, by hypothesis, both of these systems are consistent, we are forced to choose another criterion. We now investigate which of the theories is the more adequate, that is, which of the two is more complete in its explanation of experiences. The one which is more complete is preferable. But adequacy is a decidedly uncertain test. The number of possible experiences is so vast—perhaps infinite—that it would be impossible to check the two systems completely in this fashion. In applying the criterion of adequacy a customary device of the empirical sciences is employed; one moves from asserting the consequent (experiences) to the antecedent (the respective hypotheses or assumptions). A theory can be verified only by inspecting its consequences, and comparing these with experience. Thus this criterion gives probability judgments only. The system which seems to be the more adequate has the higher probability of being true.

Thus adequacy is a formal mathematical criterion, and not a

pragmatic method of choice. If no experience is discovered which contradicts an hypothesis, that hypothesis has a certain probability of being true. Of two hypotheses, the one which is consistent with the more experiences has the higher probability. A negative experience immediately destroys the hypothesis, while the more affirmative experiences there are discovered which strengthen the hypothesis, the greater is the probability that unexamined experiences will be consistent with it. It follows from this that adequacy is a purely formal matter, and hence *the truth to which the inductive methods approximate is strictly formal truth.* The two hypotheses in our example are, respectively, an anima and an autonomous physico-chemical machine.

Suppose, further, that the two theories are equally adequate. Either the simpler must be chosen, or an impasse admitted. The history of philosophy shows that when a situation such as this one arises, philosophers will recast their ideas in such a manner that the necessity of assuming either anima or machine is removed. The controversy of mechanism and vitalism is itself a product of more general philosophical assumptions and concepts. Since a certain set of assumptions leads to contradictory conclusions, it follows that the set is untenable. It is discarded in favor of a new set, generally involving new concepts, from which the contradiction does not follow. In the Whiteheadean philosophy, for instance, there is no such problem as the one of mechanism and vitalism. This is not because it has been neglected, but because prior assumptions and concepts are such that it can not arise. The problem has not been solved; it has been annihilated. Yet if philosophy attempted to discover truths about reality, this could not be done. If the entities philosophers use to explain reality were real in themselves, they could not be created and annihilated as they continually are. Philosophy seems to be but a set of systems, its problems and its entities being functions of these systems. An adequate philosophy can not ignore experience, but it can circumvent the assertion of judgments of reality.

Russell uses the expression "ultimate constituents" of the world. He says, for instance, in *Analysis of Mind* (p. 124), that there are such things as we see no means of analyzing. As a matter of fact, they are unanalyzable because they are the primitive elements of his system. The ultimate constituents of one philosophy are the derived ones of another. He writes (*loc. cit.*), "In Lecture V we found reason to think that the ultimate constituents of the world do not have the characteristics of either mind or matter as ordinarily understood." This is so because he has accepted something else as logically primitive, and builds up the concepts of mind and

matter from this. In some philosophies, mind is the ultimate constituent in terms of which matter, events, aspects, universals, etc., must be defined and explained. Or if matter is taken as primitive, these other concepts are constructs of it. The choice of the system's basic terms determines the ontological status of the derived constituents. But that status is relative to the system. Thus in one system, matter and mind are but logical abstractions defined in terms of eternal objects and events; in another both are real and equally primitive; in a third matter alone is real, and mind an epiphenomenon; in a fourth, all reality is described in terms of mind. "Reality" is what the philosopher chooses to make it. Some of these systems may be equivalent, but, if so, then in the logical sense explained earlier. And what of material or transcendent truth? It has been forgotten.

I believe that we are forced to admit that *rationally* there is no set of absolutely ultimate constituents. We know that there is no one set of absolutely primitive geometrical objects. So likewise in philosophy. Eternal objects, sensible particulars, mind, matter, or combinations of these may each be chosen as ultimate. With sufficient ingenuity a system can be developed from any of these. Adequacy and simplicity are probably the only criteria with which one chooses a particular system.

"An anima exists" is a true proposition in one system; false in another; meaningless in a third. The failure to recognize the importance of the system has led to the vast amount of pointless philosophical criticism that exists. Arguments, criticisms, and discussions, to be relevant, must take cognizance of assumptions and definitions. Many of these are futile because disputants fail to make use of the same definitions. Critics often attack theories by lifting them out of their systems (generally implicit) and showing that they fail to hold with respect to other (implicit) assumptions. No example is more pertinent than the criticisms of proofs of the existence of God. There is no difficulty in developing such a proof; it is merely a question of finding the proper premises. And if the deduction is valid, He does exist—in that system. It is then true, but formally only as far as can be known by reason, that God exists. This explains why the gods of Plato, Aristotle, Descartes, Spinoza, etc., not only differ among each other, but also fail as satisfactory objects of worship. The gods of philosophies are metaphysical principles; the god of worship is an object of faith or of mystical insight transcending systems.

The only subjects of critical discussion are adequacy of system and validity of deduction. While assumptions and definitions are not subject of attack with respect to their "truth," they may be

attacked as to their pragmatic values. It is thoroughly unjustifiable to attack conclusions without regard to premises. If each writer were to state explicitly his universe of discourse, his postulates, and his definitions, most disagreements would disappear. This also applies to arguments concerning practical affairs, as we shall see.

What has been said so far applies equally well to scientific investigations. It is unnecessary here to argue that every scientific study must presuppose certain principles according to which the investigation is carried on. The scientist, like the philosopher, builds systems. When he, in his inductive studies, approximates the truth, he approximates formal truth; i.e., he increases the probability that a certain proposition is true of or consistent with a system. The "real" world is a function of the system. As a scientist he does not know of any other real world. His criteria are consistency, adequacy, and simplicity. The structure of propositions he is developing is not questioned until he discovers an internal inconsistency or an experience not explainable by it. If an experience is found which is inconsistent with his structure, the latter is recast. Consistency and adequacy are his chief judges. Like the philosopher, the scientist creates and annihilates entities. Within a system such an entity is real, but it is merely a function of that system; it is an hypothetical entity created to explain certain experiences with respect to certain assumptions. If the assumptions are discarded, so also are generally the entities associated with them. The ether is such an entity. Einsteinian relativity has not *disproven* the existence of the ether; it has *assumed* that there is no ether in the sense that it is a fixed framework.

III

The entire preceding discussion has consistently refused to consider a point which might have destroyed its main thesis. Is material or formal truth the truth asserted of the judgments of experience? Most rational thinking deals with the results of experience, and hence we must turn to it. Many contemporary philosophers believe that the systematic principles underlying technical thinking function likewise in lay thought. The essential characteristics of systems are also present in the cognition of ordinary experiences and sense perception in general. Reference is here made not to the act of sensing, but to judgments of experience. Lewis, in his *Mind and the World Order,* has argued this point of view so cogently that much need not be said here. As a matter of fact, this paper could be considered a further deduction of his point of view.

The analyzed meaning of a concept (rather than its dictionary

definition) is a set of propositions related by implication; it is a system. The various Euclidean geometries may be considered to be analyses of the concept "Euclidean space." Huntington's articles on "betweenness" are exhaustive analyses of the meaning of that triadic relation.

A concept entails properties which constitute its meaning. This can be expressed by a number of "if . . . then" propositions relating the concept to its properties by the implicational relation. Such an analysis of mathematical concepts is familiar, but non-mathematical ones can also be defined thusly. "If this stuff is sodium, then it is chemically irreducible"; "If this is sodium, then its crystalline form is tetragonal"; If this is sodium, then its specific gravity with respect to water is 0.971"; "If this is sodium, then its melting point is 97° C."; etc., etc. This analysis has not stated that sodium exists. It is an analysis of a pure *a priori* concept. Such can be made at will. I can define a chemical which does not exist, or which can not exist because it entails incompatible characteristics.

If to the statements describing the pure concepts is added an existential proposition, it is transformed into an empirical concept, while the implicational propositions become predictions of possible experience. Error of judgment may creep in during the application of this set of propositions to experience, while verification consists in discovering whether the predictions are fulfilled. The situation here is precisely the same as that already described of inductive reasoning. The proposition "This is a book" is true if the predictions entailed in the book-concept are fulfilled. If this thing looks like what the pure concept of book requires, feels like a book, it probably is a book. If it is opened, and we find a hollow interior for cigars, then a prediction has failed; an inconsistency has been discovered; it is not a book. Again where we have looked for material truth, we have found consistency. The perfect liar is a contradiction in terms. If a perfect liar is one who is so consistent in his lying that he is ever guiltless of asserting contradictions, then he is, *a fortiori*, a perfect truth-teller. Thus by the principle of the identity of indiscernibles, Satan and God are one.

The scientist using his senses in experimentation and the layman pursuing his search for the acquisition of bread and butter rely on formal systems as much as does the logician at his desk. We, as laymen, are notoriously pragmatic, in the sense that we are satisfied with consistency and adequacy. In the ordinary activities of living all we desire is that our experiences shall coincide with what we expect them to be. This means that our experiences shall be subsumed under our *a priori* concepts, and we accept that sub-

sumption to be correct when our "expectations," to use Russell's word, of the future are verified. We do not care whether the automobilist "really" sees green or red, but whether he will consistently see the same colors, and drive accordingly.

But it is not the intention of this paper merely to argue that we don't care about material truth. The attempt has been made to show that without transcendent insight we can only discover or approximate the discovery of formal truth in science, in philosophy, and in life. We have tried to show that all rational thinking is within systems. Perhaps there is no real world beyond our systems. Our systems may constitute real worlds. This question falls outside of the scope of this paper. If this is so, formal and material truth coincide; if not, the mystic has his advantage.

KURT EDWARD ROSINGER.

HARVARD UNIVERSITY.

BOOK REVIEWS

Symbolic Logic. C. I. LEWIS AND C. H. LANGFORD. The Century Philosophy Series. New York: The Century Co. 1932. Pp. xi + 506.

The publication of this new *Survey* is an event of first rate importance, for it is the work of two mature minds and it expresses living thought. Where the tradition of science has left behind results of some finality the exposition is sometimes brilliant and always masterful and where matters are in doubt the criticism is free and always searching. One has the pleasure of watching two minds at work, oftentimes as if one were reading "logical confessions" expressed as freshly as in Russell's *Principles.* All this is of the greatest value in a "text," for only by watching minds at work does a beginner come to understand how work is done. Such books are rare. Commonly an author conceals his weaknesses, erases his false starts, and puts down only what he thinks is sound. How much inspiration and how much wisdom must Gauss have buried in his waste-paper basket! Like any technical work this book defies summary, but it will still be possible to touch on certain critical points.

In his *Survey* (University of California, 1918, p. 291) Professor Lewis says: "The systems discussed in the last chapter were all based on material implication, $p \subset q$ meaning exactly 'the statement p is true and q is false is a false statement.' We have already called attention to the fact that this is not the usual meaning of 'implies.' Its divergence from the 'implies' of ordinary inference is exhibited in such theorems as 'A false proposition implies any proposition' and 'A true proposition is implied by any proposition.'" This is

one of the characters that distinguishes material implication from strict implication.

Again in *Symbolic Logic* the point is frequently repeated: "By contrast [with material implication] $p \dashv q$ . . . is not determined to be either true or false in the other three cases [p true, q true; p false, q true; p false, q false]; whether it holds or not depends upon something else than merely the truth or falsity of p and q (p. 200)." Whether it holds *or not!* This is dangerous ground and it is hard to see why the system should be compromised by introducing it. The intent is clearly to make inference depend on "form," but formal distinctions are constantly lost in special cases or in the process of what Schroeder calls "specialization." No, on this point the *Principia* is as sound as a nut. It has borrowed to its profit from sound tradition. If this is not what ordinary inference means, it is what inference must come to mean if it is to be general. Our author has not here discovered the Achilles' heel of *Principia* which lies precisely in the fallacious conversion of

$$p \subset q \,.\subset.\, -p \vee q.$$

It is to be noticed that the system of "strict" implication developed in the *Survey* is very different from that now presented under the same name in *Symbolic Logic*. In the *Survey* we read (p. 293):

$$1.02 \quad p \dashv q = \sim(p - q),$$
$$1.04 \quad p \vee q = \sim(-p - q).$$

If these are generally true we may substitute in the first q = zero and in the second $p = -p$, q = zero, which would yield,

$$p \dashv 0 = \sim p,$$
$$-p = \sim p \quad \text{(by 2.51, p. 297)},$$

if zero is the modulus of addition.

This however wipes out the essential distinction, that is, if we press the matter further,

$$p \dashv q = p \subset q,$$
$$p \vee q = p + q, \text{ etc.},$$

and the system is no longer distinguishable from that of material implication.

In *Symbolic Logic*, however, Professor Lewis takes the essential step to rectify his system. He writes (pp. 141–142): "The definition of material implication has the force of the following pair:

$$(1) \quad p \supset q \,.\dashv.\, \sim(p \sim q),$$
$$(2) \quad \sim(p \sim q) \,.\dashv.\, p \supset q.$$

The analogue of (1) for strict implication holds: it is,

$$p \dashv q \,.\, \dashv \,.\, \sim(p \sim q).$$

. . . But the analogue of (2) which would be

$$\sim(p \sim q) \,.\, \dashv \,.\, p \dashv q$$

is false. It can be proved that it is not deducible from our postulates."

The equality of the *Survey*,

$$p \dashv q = \sim p \vee q,$$

is thus *correctly* abandoned as fallacious and the reviewer can only feel gratified that this character of implication has at last been recognized by some one other than himself. For the last ten years he has repeatedly called attention to it (see, for example, his *Symbolic Logic*, pp. 17–18, 34, 131–132).

The next step in the development of the system of inference (which Professor Lewis does not take, and may, indeed, not be willing to take) is to introduce a fundamental expansion formula which enables us to express the product of any number of variables implying zero in terms of a sum of products of functions of the single variables. This formula, which we hope we express correctly in Professor Lewis's symbolism, would read:

$$\Diamond(pq) = pq \vee (\sim p \sim q) \,.\, \Diamond p \,.\, \Diamond q \vee \Diamond p \,.\, \sim\Diamond(\sim q) \vee \Diamond q \,.\, \sim\Diamond(\sim p),$$

from which follows by the ordinary laws of the calculus the theorem,

$$\sim\Diamond(pq) = \sim\Diamond p \vee \sim\Diamond q \vee \sim qp\ \Diamond(\sim p) \vee \sim pq\ \Diamond(\sim q),$$

and the formulas for the expansion of functions of higher order and degree can now be progressively developed.

The importance of these formulas lies in the fact that they reduce the solution of the most general problem of logic to the solution of a comparatively simple case. These matters once carried out, implication loses all its adjectives and becomes not "strict" but implication simply.

However, the theory of implication as Professor Lewis and his collaborators are working it out, is on most points far from settled in their own minds (cf. the extraordinary proposal C 13., along with a number of false postulates by Becner, p. 497). For example, in the second Appendix there appears, on the authority of Dr. Wajsberg and Dr. Parry, the theorem,

$$p \dashv q \,.\, \dashv : q \dashv r \,.\, \dashv \,.\, p \dashv r,$$

which is said to result from the revised *Survey* postulates (this

JOURNAL, Vol. XVII (1920), pp. 300–302), and Professor Lewis observes: "I doubt whether this proposition should be regarded as a valid principle of deduction," etc.

Now if Professor Lewis and his collaborators will express this in terms of their modal function, then by a repeated application of the expansion formulas given above all doubts will be removed. The work is somewhat long, but the result can be depended upon, if my formulas are correctly expressed in the author's symbolism.

One matter which caused the reviewer no little surprise was the treatment of traditional logic as contained in the chapter on the logic of terms. This criticism which begins with Leibnitz and extends to our own day has never been more admirably put, but one would not have expected the chapter to close without its having met its answer.

The whole fallacy of this criticism consists in the assumption that the "all, is" relation of traditional logic must be identified with the relation of Boolean inclusion, whereas it is actually to be represented as a rather complicated function of that relation. The device of extending the meaning of a relation symbol to overcome some obstacle of interpretation is a very common mathematical procedure and could be illustrated in many ways. Following long established method, then, we extend the meaning of the "all, is" relation and we write not

$$\text{all } a \text{ is } b = a \supset b,$$

which would be an oversimplification of the actual state of affairs, but

$$\text{all } a \text{ is } b = (a \supset b) \,.\, \{(b \supset a) + -(a \supset -b) \,.\, -(-b \supset a)\}.$$

On this interpretation, which coincides with the other for all "empirical" meanings of a and b and differs only in the limiting cases, all the postulates of Aristotle's logic hold true in a perfectly general sense, that is, without any restriction whatever as to what the terms may mean. To get "no a is b" we have simply to change b into $-b$ in the formula and it is then easy to see that the product of A and E vanishes for all meanings of the terms, so that subalternation holds true unexceptionally.

All the "valid" moods of the syllogism hold. For example, to prove the syllogism *EAO* in the third figure (fallaciously stated on p. 50 to be fallacious) we simply multiply together,

$$E(ba) = (b \supset -a) \,.\, \{(-a \supset b) + -(b \supset a) \,.\, -(a \supset b)\},$$
$$A(bc) = (b \supset c) \,.\, \{(c \supset b) + -(b \supset -c) \,.\, -(-c \supset b)\},$$
$$A(ca) = (c \supset a) \,.\, \{(a \supset c) + -(c \supset -a) \,.\, -(-a \supset c)\},$$

and observe that the terms in the product vanish identically.

Nothing could be more masterful than Professor Langford's exposition of the logical paradoxes and his manner of classifying them. For the reviewer a great many of these turn on the familiar case of the confusion of the use of "all" in the collective and in the distributive sense. In order to control the meaning of "This proposition is false," for example, we must define the parts that enter into the assertion. If we write: $f(p) = p$ is false and $\phi(p)$ is the form of the assertion about p, ϕ standing for what the authors would call some modal function of p, then we define "is false" as any f which satisfies $f(f) = \phi(f)$ and we define "this proposition" as the roots of the equation,

$$\{f \supset f(f)\}' \cdot \{f(f) \supset f\}' = 0.$$

This makes "this proposition" a two-valued function, ambiguously zero or one, so that $p = f(p)$ for the two values taken collectively, but not for the two values taken distributively.

We began by saying that the new logic is a work of first-rate importance and we should like to end on the same note. One can be thankful for an undertaking that is ripe and thorough even when one does not "go along" with every argument that turns on a critical point.

HENRY BRADFORD SMITH.

UNIVERSITY OF PENNSYLVANIA.

JOURNALS AND NEW BOOKS

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NOTES AND NEWS

To the Editors of the Journal of Philosophy:

Mr. S. P. Lamprecht, in No. 5, Volume XXX of your Journal, has commended my recent book on Hume far beyond its merits, and, as a matter of course, has shown on every page how thoroughly he has studied Hume and Hume's period. My vanity, therefore, together with my great respect for Mr. Lamprecht's attainments make me very reluctant to point out, what in view of the importance of the matter—so far as these things *are* important—I think I have to point out, viz., that he has made a slip, and that in making it he has misrepresented me.

In his footnote to p. 131 Mr. Lamprecht says that I "do not seem to take into account" the conflict between Newtonianism and Cartesianism, and also suggests that when I spoke of Hume's criticism of the "ancients" as being in "the usual Newtonian-Cartesian vein" I should be presumed to be lumping the Cartesians and Newtonians together quite generally, although, in that particular instance, I happened to say what was historically correct.

I should like to remark that on p. 6 of my book and somewhat more forcibly on p. 101 I made it quite clear that "experimentalism" was a different philosophy from "waning Cartesianism" with

its "*idées claires*" and that I discussed (as I thought rather fully) the main relevant points of disagreement between these parties, viz., whether Newtonian "gravity" was truly "intelligible" (e.g., in my quotation from Roger Cotes on p. 37 n), or, again, regarding the alleged intelligibility of the communication of motion by impact (where Hume, as I showed on p. 137 drew upon the criticisms that the relativity heterodox Cartesian Malebranche made upon the standard Cartesian view). I did, therefore, make *some* use of the opposition between these parties; and it never occurred to me to suppose that a phrase correctly stating the common opposition of both Cartesians and experimentalists to scholastic "forms" and "qualities" could suggest to any one that they agreed on other matters.

No doubt, if Hume's principal object, or even if one of his principal objects, had been to attack the Cartesianism of Locke—in his reference to the Cambridge Platonists Mr. Lamprecht seems to have forgotten the argument of Henry More's *Enchiridion Metaphysicum*—I should justly be censured for not having referred much more fully than I did to the controversy between Newtonians and Cartesians; and the censure may be deserved on other grounds not indicated by Mr. Lamprecht, but possibly present to his mind. I can not believe, however, that Hume expressly and consciously intended to attack a carefully selected part of Locke's theory. When he set himself to attack *a priori* demonstrations of the causal principle he cited Hobbes, Clarke, and "others," as well as "Mr. Locke" (*Treatise*, Book I, Part III, Section III); and his reference to the Cartesians in Section XIV regarding "the secret force and energy of causes" was of the type that I should call constructive, not polemical, criticism.

Obviously this explanation, on my part, has no bearing upon most of the important questions of interpretation that Mr. Lamprecht raises in his valuable and (to me) very interesting review. I could not deal with these briefly, and it is no part of my present purpose even to suggest that I was right, although my silence should not be taken to imply that I allow I was wrong. I want to point out, quite simply, that Mr. Lamprecht, in the way that happens to all of us, has made a slip.

JOHN LAIRD.

KING'S COLLEGE, ABERDEEN.

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